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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CARLOS DANGELO

Appeal 2009-0076
Application 10/762,666
Technology Center 2800

Decided:[1] February 23, 2009

Before JOSEPH F. RUGGIERO, JOHN A. JEFFERY,
and KARL D. EASTHOM, *Administrative Patent Judges*.

EASTHOM, *Administrative Patent Judge*.

DECISION ON APPEAL

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[1] The two month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134 from the Examiner's rejections of claims 28-32. The Examiner withdrew claims 1-21 pursuant to a restriction requirement and Appellant's subsequent election (*see* Office Action, mailed May 9, 2005). Appellant canceled claims 22-27. No other claims are pending. (App. Br. 3).[2] We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

Appellant's invention relates to heat conductive media within vias of an integrated circuit structure, thereby cooling the structure. In one embodiment, the media comprises carbon nanotubes, and in another, copper. (Spec. 5: 1-10; 9: 11-15; Fig. 1).

Claim 28, illustrative of the invention,[3] follows:

28. An integrated circuit die having enhanced power dissipation, comprising:

a substrate, having a top surface upon which power generating-devices of said integrated circuit die are fabricated, said substrate having a backside surface essentially parallel to said top surface;

at least one cavity, extending from said backside surface a predetermined distance toward said top surface, said predetermined distance

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[2] Appellant's Brief (filed Feb. 14, 2007) ("App. Br.") and Reply Brief (filed Jul. 17, 2007) ("Reply Br."), and the Examiner's Answer (mailed May 17, 2007) ("Ans."), detail the parties' positions.

[3] Claim 29 differs from claim 28 only in the material of the heat conducting media recited - "carbon nanotubes" in place of "copper."

being less than the distance between said top surface and said backside surface; and

a heat conductive media contained within said at least one cavity, said media having a thermal conductivity greater than a bulk thermal conductivity of said substrate, such that heat produced by said power generating devices is transferred to the backside surface via said heat conductive media, wherein said heat conducting media comprises copper.

The Examiner relies on the following prior art references:

Cromwell	US 5,926,370	Jul. 20, 1999
Dahl	US 2002/0130407 A1	Sept. 19, 2002[4]
Montgomery	US 2003/0117770 A1	Jun. 26, 2003 (filed Dec. 20, 2001)[5]

The Examiner rejected claim 28 as obvious under 35 U.S.C. § 103(a) based upon the teachings of Dahl and Cromwell.

The Examiner rejected claims 29-32 as obvious under 35 U.S.C. § 103(a) based upon the teachings of Dahl and Montgomery.

ISSUES

Appellant contends that the references neither enable nor motivate skilled artisans to arrive at the particular heat conducting media materials, respectively copper and carbon nanotubes, as recited in claims 28 and 29. (App. Br. 9-19). The issues before us on appeal are:

[4] Dahl's published application matured into a patent, US 6,783,589 B2 (Aug. 31, 2004).
[5] Montgomery's published application matured into a patent, US 6,965,513 B2 (Nov. 15, 2005).

Did Appellant demonstrate that the Examiner erred in finding that Dahl and Cromwell collectively teach a heat conducting media comprising copper as set forth in claim 28?

Did Appellant demonstrate that the Examiner erred in finding that Dahl and Montgomery collectively teach heat conducting media comprising carbon nanotubes as set forth in representative claim 29?[6]

FINDINGS OF FACT (FF)

1. Appellant states: "A number of deposition techniques are known for growing carbon nanotubes. Preferably, the carbon nanotubes are grown using plasma enhanced chemical vapor deposition (PECVD), as has been recently reported in the scientific literature and is known to those skilled in the art." (Spec. 9:26-29).

2. Appellant also states: "The current art uses multiple metal layers, insulated by dielectrics, and connected layer to layer by vias. Innerconnect conductors are made of metals such as tungsten, aluminum and/or copper." (*Id.* at 2:26-28).

3. Dahl discloses heat conducting conduits 631, 632 embedded into a back surface of an integrated circuit chip 601 with circuits on the top surface. The heat conducting conduits may be flexible fibers or rigid rods, made of diamondoid-containing materials. (Dahl ¶¶ [0117], [0121], [0122]; Figs. 6B, 6C).

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[6] Appellant does not separately argue that claims 30-32 are patentable, but focuses on independent claim 29 (App. Br. 16-18), hereby selected as representative of the group, pursuant to 37 C.F.R. § 41.37(c)(1)(vii).

4. Dahl states that such diamondoid materials, whether in the form of rods 630 or a film 620, can be deposited to create the configurations of either Figure 6B or 6C by CVD techniques, or by "self-assembly techniques." (*Id.* ¶ [0122]).

5. Dahl discloses that diamondoids and carbon nanotubes are forms of carbon. (*Id.* ¶¶ [0014], [0019]). Referring to fullerines "and their counter parts carbon nanotubes," Dahl states (*id.* ¶ [0014]): "Though discovered recently, these materials already have a potential role in microelectronics applications." Dahl describes diamondoids as "[a] form of carbon not discussed extensively in the literature." (*Id.* ¶ [0019]).

6. Cromwell discloses a heat management device to cool an integrated computer apparatus that includes a CPU or VLSI module connected to a printed circuit board, a power converter, cables, and supporting structure (Abstract). An array of copper pipes 31 cools the components of the integrated device structure by transferring heat to heat fins. (Cromwell, Fig. 4a, col. 10, ll. 13-32).

7. Montgomery discloses "a thermal interface structure . . . formed from an array of aligned carbon nanotubes." (Montgomery, ¶ [0013]). Due to their high thermal conductivity, "using them in a thermal interface structure will substantially increase its thermal conductivity." (*Id.*). "Such arrays are available from Nano-Lab, Inc., which manufactures them using a chemical vapor deposition process described in an article of Dr. Z.F. Ren in Science, 282, 1105 (1998)." (*Id.* ¶ [0014], Figs. 2, 3). The arrays (of bundles 24 of nanotubes 26) are grown on a variety of substrates 28, including glass and silicon, from which they project. (*Id.*). Montgomery discloses that the arrays can be grown to project from either a

"semiconductor die" or "heat sink" to produce "a particularly strong thermal bond." (*Id.* ¶ [0023]).

8. Dahl's and Montgomery's published applications issued as United States patents prior to the Examiner's Office Action, mailed July 17, 2006 (*see* nn. 4, 5, *supra*), from which Appellant appeals.

PRINCIPLES OF LAW

"[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). "On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of *prima facie* obviousness . . . ." *Id.* at 985-86 (quoting *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998)).

"[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 127 S.Ct. 1727, 1740 (2007) (quoting *Sakraida v. Ag. Pro. Inc.*, 425 U.S. 273, 282 (1976)). "[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result." *Id.* (citing *United States v. Adams*, 383 U.S. 39, 50 (1966)).

"The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference . . . . Rather, the test is what the combined teachings of those

references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

"[T]he interaction of multiple components means that changing one component often requires the others to be modified as well." *KSR*, 127 S.Ct at 1744. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." *Id.* at 1742.

Inventions disclosed in the applied prior art references enjoy a statutory presumption of validity if the applied prior art references are U.S. patents. 35 U.S.C. § 282 (1999); *In re Spence*, 261 F.2d 244, 246 (CCPA 1958). The enablement requirement under 35 U.S.C. § 112 is a prerequisite to validity. *Cf. Spence*, 261 F.2d at 246. It follows that prior art patents are presumed enabling absent clear and convincing evidence to the contrary.

ANALYSIS

Appellant's assertions (App. Br. 9-16), with respect to claim 28, that Dahl and Kumar do not teach a copper heat conductive media within the cavity of the die, lack merit. As the Examiner found (Ans. 4-5), Dahl teaches all of the claimed subject matter (FF 3) except the specific type of heat conductive material recited, copper. Appellant does not seasonably dispute this finding. As the Examiner also found (Ans. 5), Cromwell simply teaches the recited material, copper, as a conventionally employed heat transfer conduit for integrated circuit packages (FF 6). Substituting Cromwell's heat-conducting copper conduits for Dahl's heat conducting diamondoid conduits (FF 3), as the Examiner proposed (Ans. 5), "with each performing the same function it had been known to perform and yield[ing]

no more than one would expect from such an arrangement", would have been obvious. *KSR*, 127 S.Ct. at 1740.

Appellant's reliance (App. Br. 9) on enablement requirements outlined in *In re Kumar* 418 F.3d 1361, 1368 (Fed. Cir. 2005) lacks merit. Appellant asserts (App. Br. 11, *see also* App. Br. 13) that Dahl or Cromwell fail to enable a skilled artisan as to: "(1) how to make copper (or even diamondoid) conduits in fiber form . . . (2) how to insert from about 1 to 100 copper (or even diamondoid) conduits into the chip; or (3) how copper (or even diamondoid) conduits would 'communicate' with thermal vias . . . ."

As the Examiner reasoned (Ans. 7-9), Dahl was not applied to teach copper, and neither Dahl nor Cromwell were applied to teach each and every particular item Appellant lists.[7] In any case, Cromwell, a valid patent, and Dahl's published application, which matured into a valid patent at the time the Examiner employed its teachings (FF 8), are presumed to be enabling for what they disclose, contrary to Appellant's assertions. *See Spence*, 261 F.2d at 246.

As such, Appellant's conclusory remarks, devoid of the type of rebuttal evidence addressed in *Kumar*, fail to rebut the Examiner's prima facie case of enablement for such a simple substitution of prior art elements or materials. "The applicant has the burden of coming forward with

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[7] "Even if a reference discloses an inoperative device, it is prior art for all that it teaches." *Beckman Instruments v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989)(citations omitted). "[A] non-enabling reference may qualify as prior art for the purpose of determining obviousness under § 103." *Symbol Techs. Inc. v. Opticon Inc.* 935 F.2d 1569, 1578 (Fed. Cir. 1991) (citing *id.* at 1551, another citation omitted). Thus, items not germane to the claimed invention need not be enabled, contrary to Appellant's remarks.

evidence in rebuttal, when the prior art includes a method that appears, *on its face*, to be capable of producing the claimed composition." *Kumar*, 418 F.3d at 1368 (emphasis added).

Dahl's method, "appears, on its face, to be capable of producing" diamondoid conduits emanating from a semiconductor substrate cavity. (FF 2-4). Each protruding conduit defines "at least one cavity," as required by claim 28; i.e., each cavity surrounds a conduit in the circuit die substrate. Appellant admits that making metal vias of copper was standard in the art (FF 2). Replacing Dahl's diamondoid heat transfer conduits with copper conduits, using either known copper via fill techniques (FF 2) or Dahl's "self-assembly techniques" (FF 4), would have been well within the skilled artisan's expertise.

Appellant's arguments (App. Br. 14-16) directed to an alleged lack of motivation also fail to demonstrate error. Either of the Examiner's rationales for replacing Dahl's diamondoid heat transfer conduits with Cromwell's standard copper heat transfer conduits, with each conduit type generally employed in semiconductor integrated packages (FF 3, 6), including such rationales as simplicity of fabrication, and/or functional equivalents (*see* App. Br. 15, quoting the Examiner's dual rationales), satisfies the Examiner's obviousness burden under *KSR* and *Kumar*. Dahl's diamondoid pipes, representing an advancement in the art (FF 5) over copper vias or pipes, logically implies that copper represents a simpler alternative. Appellant has failed to rebut the Examiner's supported finding.

Appellant's argument (App. Br. 13-14) that the Examiner's proposed combination would involve a substantial reconstruction and redesign of Dahl's system, due to Cromwell's "macroscopic heat pipes," also lacks

persuasive merit. Replacing one pipe or conduit for another, as the Examiner proposed, involves no such reconstruction or redesign. Even if the modification required a redesign, under *KSR*, 127 S.Ct at 1742, ordinarily skilled artisans are not automatons who lack the ability to make simple size alterations or other similar adjustments as required to combine interconnected components. Moreover, under *Keller*, 642 F.2d at 425, a bodily incorporation of Cromwell's copper pipes into Dahl's semiconductor is not the test for obviousness.

With respect to claim 29, Appellant makes similar arguments, based primarily on an alleged lack of enablement, and contends that Dahl and Montgomery fail to teach carbon nanotubes as heat conductive media within the cavity of a die. (App. Br. 16-19; Reply Br. 11-13). Appellant's arguments fail for similar reasons as outlined above.

Montgomery, "on its face" (*Kumar*, 418 F.3d at 1368), enables skilled artisans to produce what Montgomery discloses: carbon nanotube conduit arrays embedded into semiconductor substrates (FF 7). Moreover, under *Spence*, 261 F.2d at 246, Montgomery's application, which matured into a valid patent (FF 8), is presumed to be an enabling reference. Additionally, Appellant admits that techniques for making such carbon nanotubes were well known (FF 1). Under *Kumar*, Appellant's conclusions, based on alleged deficiencies of enabling references, are devoid of any supportable evidence as required to rebut the Examiner's prima facie case of obviousness (Ans. 5-7).

Contrary to Appellant's further arguments (App. Br. 18-19), as noted *supra*, Montgomery specifically discloses heat conductive carbon nanotubes arrays embedded within a semiconductor die, produced by using standard

industry practice or obtained on the market (FF 7). As discussed *supra*, Dahl similarly discloses embedded heat conductive conduits made of a similar carbon material, albeit, a diamondoid carbon material, produced by standard techniques (FF 3-5). As the Examiner generally reasoned (Ans. 6-7), and under *KSR*, such a simple substitution of one element for another, each providing a specific desired thermal conductivity for cooling or heat transfer, would have been obvious. Such a simple replacement also, would have been, on its face, enabled.

Accordingly, Appellant's arguments do not convince us of error. Therefore, we sustain the Examiner's rejections of independent claims 28 and 29, and dependent claims 30-32, which were not separately argued.

CONCLUSION

Appellant did not demonstrate that the Examiner erred in finding that Dahl and Cromwell, or Dahl and Montgomery, collectively teach a heat conducting media comprising copper or carbon nanotubes as set forth, respectively, in claims 28 and 29.

DECISION

We affirm the Examiner's decision rejecting claims 28-32.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

msc

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